



Non-inductive current probe

Bak, Christen Kjeldahl

Published in:
Review of Scientific Instruments

Link to article, DOI:
[10.1063/1.1135203](https://doi.org/10.1063/1.1135203)

Publication date:
1977

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Bak, C. K. (1977). Non-inductive current probe. *Review of Scientific Instruments*, 48(9), 1227-1227.
<https://doi.org/10.1063/1.1135203>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

The design has been used for over two years in our laboratory, never showing superleaks on thermal cycling tens of times without disassembly. The only precaution taken is to use a new ring whenever it is necessary to take apart and reassemble the can.

The assistance in this design of J. Massink and H. Weijers is gratefully acknowledged.

¹ M. Kuchnir *et al.*, *Rev. Sci. Instrum.* **42**, 536 (1970).

² J. E. Vesel, *Rev. Sci. Instrum.* **43**, 1390 (1972).

Noninductive current probe

C. K. Bak

Physics Laboratory I, The Technical University of Denmark, Dk-2800 Lyngby, Denmark

(Received 18 May 1977)

The current probe described is a low-cost, shunt resistor for monitoring current pulses in e.g., pulsed lasers. Rise time is < 5 nsec, inductance introduced in the circuit < 7 nH, and current handling capability ~ 100 A² sec.

DESCRIPTION

The resistance element is made from a stainless steel tube of 4.0-mm i.d. Wall thickness is reduced to 0.15 mm by turning. Current is fed into one end of the tube by means of a small brass plug, insuring a uniform current distribution. The other end of the tube is soldered to a brass body serving as current return path. The voltage drop across the stainless steel tube is fed to a BNC connector screwed into the brass body. A 47- Ω carbon resistor prevents re-reflections.

Due to the cylindrical symmetry the magnetic field from the main current will vanish inside the resistance element. The inductive coupling between "current leads" and "voltage leads" is thus eliminated.

Rise time is limited by skin effect in the stainless steel tube. (Note that in this geometry the voltage measured across the tube decreases as the frequency increases.) Since skin depth depends on frequency f as $f^{-1/2}$, marked improvements are possible by further turning or grinding the stainless steel tube.

It should be noted that commercially available thin-walled tubes made from "Monel," for example, should be avoided due to their magnetic properties.

The shunt described was tested as one part of a voltage divider, the other part being a 47- Ω , coaxially mounted, carbon resistor. Amplitude and phase response of the dividing ratio was measured in the frequency range 10–200 MHz, using a vector voltmeter. From the test results the following data were obtained:

Resistance	31 m Ω
Upper frequency limit (3 dB)	76 MHz
Rise time (10%–90%)	4.6 nsec
Group delay	2.0 nsec

A clean roll off without any overshoot was observed. Inductance introduced in the current path can be calculated to be 6.7 nH.

In practice current handling capability is thermally limited. A rough calculation indicates a 10 °C temperature rise of the resistance element resulting from a 100-A² sec pulse.

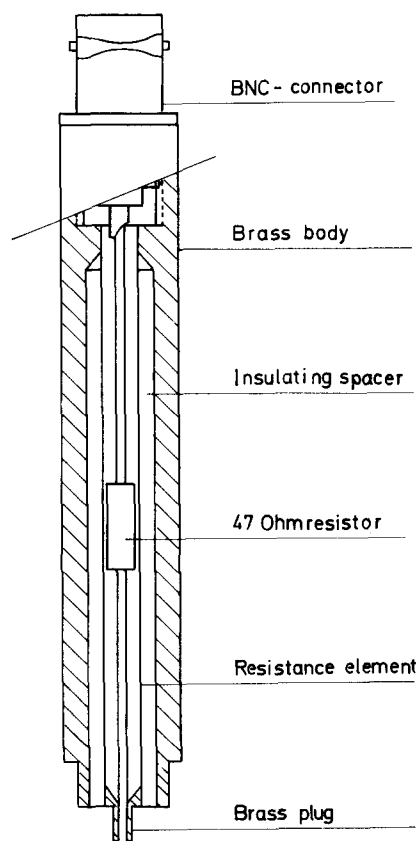


FIG. 1. Current probe, partial sectional view. Active length of the resistance element is 65 mm.